

[Detailed Statement]

[Name of Invention]

Temperature Sensitive State-Changing Hydrogel Composition and Method for Preparation

[Short description of Figures]

Figure 1 shows the viscosity of the Hydrogel composition measured at various temperatures.

Figure 2 shows that the hydrogel is formed by two gel type Polymers. Part (a) shows that physical bond of the branched polymer and electrical bond of the electrolyte gel polymer exists together. Part (b) shows the fluid state of the polymers where electrical bond of the electrolyte gel polymer exists but the physical bond of the branched gel polymer does not exist.

Figure 3 shows the skin care hydrogel sheet that was produced using invented hydrogel composition. Part (a) is the base that is made out of rayon textile and part (b) is the invented Hydrogel.

[Detailed Description of the Invention]

[Purpose of the Invention]

[Technical Field and Traditional Technique]

This invention is about the temperature sensitive state-changing Hydrogel composition and the method for its preparation. In detail, it is the Hydrogel composition and its method of production of the gel that transforms into state-changing condition by temperature difference which can be applied efficiently to skin as beauty care.

The state-changing Hydrogel composition means a material Hydrogel, which contains great quantity of water, changes its form into state of fluid at a certain temperature.

In Recent years, Hydrogel has been used in many areas of skin-care such as cosmetic products, and dermal treatment. Hydrogel is used as a base frame because it is suitable for the controlled release of drugs (N.A. Pappas Ed., "Hydrogels in Medicine and Pharmacy, Vol.11; Polymers", CRC Press, Inc., 1987.). This means that Hydrogel is used as a base frame with hormones such as progesterone, and then slowly releases and controls the quantity of the hormones into the body.

According to Sakai US Patent #5,344,655, a procedure to transfer drug through skin into the body using water soluble polymers such as Cellulose Derivative containing hydrogel has been already introduced.

According to Fox, US Patent #5,405,366, the technique used in transdermal drug delivery system using water soluble polymers, which form an optical bridge, contained adhesive hydrogel were introduced.

Gebner introduced in US Patent #4,593,053 the usage and production method of Hydrogel that is skin friendly and pressure sensitive.

Transdermal delivery of drugs is a technique that transfers hormones such as Progesterone, Progestin, Estrogen, and Testosterone into the body through the skin. This high level medicating system slowly releases adjusted quantity of medicine into body through transdermal from hydrogel which is attached on the skin.

Shumiller US Patent #6,215,374 introduces the composition, method, and the device of the hydrogel for efficient transdermal delivery of drugs.

Verner US Patent #5,064,654 also introduces the composition of adhesive hydrogel for transdermal delivery of drugs.

Sapota US Patent #4,942,158 introduced the composition of hydrogel that contains penetration increment additive for better transdermal delivery of drugs.

Moreover, Rolf US Patent #6,361,790 and #6,406,712 introduced a patch and dressing method of skin application using hydrogel.

All of the above traditional techniques apply hydrogel to skin, but it only releases the medicine slowly to the skin from hydrogel which is in the form of gel.

When hydrogel is in the gel state, it takes relatively long time for the medicine to penetrate into skin, and the drug could only be delivered to the limited area where the hydrogel directly contacts the skin.

To overcome this disadvantage, a penetration enhancer was added or skin friendly hydrogel was used.

Generally, unlike medical treatment on skin, when using cosmetic product for skin care a protection device is not applied for long time use on an area of the skin. It is rather applied for a short period and then removed. Hydrogel is used in this skin care system to increase effectiveness, and it is produced in sheet and patch forms to effectively apply to the skin. However, even though hydrogel is used, there are limitations when hydrogel is in the form of gel. This limitation causes delay in speed and the quantity of the drug delivery.

The friendliness between hydrogel and skin greatly effects delivery of contained drugs or medicine in hydrogel. This means, greater the acceptances faster and more effective delivery of the medicine, and lesser the acceptances slower and less effective delivery of the medicine.

When applying skincare substance contained hydrogel for beauty treatment onto skin, it needs to be removed sooner than the medical treatment product. That is, the beauty treatment hydrogel needs to deliver the substance to the skin fast and effectively. To fulfill this feature, the hydrogel needs to evenly and rapidly deliver the substance. Therefore, an innovative hydrogel that can fulfill the above characteristics is required.

[Technical Subject of Invention]

This invention is to provide the temperature sensitive state-changing hydrogel which delivers beauty substance into the skin evenly and rapidly.

The hydrogel composition changes its state into liquid which can flow due to body temperature after skin contact.

Also this invention is to provide the production method of temperature sensitive state-changing hydrogel that distributes beauty substance onto skin evenly and rapidly.

[Structure of Invention]

Temperature sensitive hydrogel composition consists of Branched Gel Polymer 1-10 wt %, Electrolyte Gel Polymer 0.5-5 wt %, Skin-friendly Enhancements 0.5-5 wt %, Natural Bio Material 1-10 wt %, Aliphatic Polyol 3-30 wt %, Functional Additive 1-10 wt % and water 30-93 wt % and transforms to the state of fluid at the temperature of 10~50 °C.

Temperature Sensitive State-changing Hydrogel has two steps for its production.

The first step (Preparation of Gel solution): At room temperature, mix Aliphatic polyol 3-30 wt % with Branched gel polymer 1-10 wt % (extracted from group of Galactomannan, Glucomannan, Guagum, Locastgum and Plutonic), Electrolyte gel polymer 0.5-5 wt % (extracted from group of Aga, Algin, Carrageenan, Xantan and Gelan), Functional Additive 1-10 wt % (extracted from group of Chitosan derivative, Proteoglucon, Elastin, Collagen and Hyaluronic acid), and 30-93 wt % water. Then increase the temperature to 45~95°C.

The second step: While maintaining the temperature at 45~95°C, sequentially add Natural Bio Material 1-10 wt % (extracted from Aloe, Green Tea, Ginseng, Wood Vinegar, Pine Needles, Ginkgo Leaf, Mulberry Leaf (Silkworm)), Skin-friendly Enhancements 0.5-5 wt % (Extracted from Metilparavin, Propilparvin, Kojic acid, α -Hydroxy Acid and Retinol), and cool it down to room temperature.

Detailed instructions are explained below.

The characteristic of temperature sensitive state-changing hydrogel composition is that it transforms from gel to liquid state at an ideal temperature of 30-40°C, generally 10-50°C. Because it enhances the acceptance level between hydrogel and skin, it delivers beauty substance or medicine evenly and rapidly.

This invention is to construct ideal and effective method of hydrogel that can be used in short time beauty treatment, and then produce suitable temperature sensitive state-changing hydrogel composition.

This temperature sensitive state-changing hydrogel composition optimizes acceptance level between hydrogel composition and skin when gel transforms into liquid state after a skincare substance contained hydrogel sheet or patch is applied to skin.

And since this hydrogel composition contains natural acceptance level enhancements, contented amount of cosmetic can be delivered into transdermal.

Therefore this study provides new hydrogel that has characteristic of temperature sensitive hydrogel that transforms its state from gel to liquid when it reaches certain temperature.

Especially, when this invented Hydrogel is used in beauty care in a form of hydrogel sheet or patch, the body temperature will change the hydrogel state to liquid so that it becomes a flowable composition. This hydrogel will automatically adhere and penetrate into the skin and increase the acceptance level greatly.

To obtain the above characteristics, this invented hydrogel composition includes gel substances that are comprised of tree type and electrolyte polymers together with acceptance level enhancer and natural bio materials to increase the acceptance level with the skin. Also, Polyhydric Alcohol and a functional substance will be added to give the liquid state hydrogel more flux.

Based on the total weight, Hydrogel composition consists of Branched Gel Polymer 1-10 wt %, Electrolyte Gel Polymer 0.5-5 wt %, Skin-friendly Enhancements 0.5-5 wt %, Natural Bio Material 1-10 wt %, Aliphatic Polyol 3-30 wt %, Functional Additive 1-10 wt % and water 30-93 wt %.

The inventors found out that when the above stated elements are included in hydrogel composition in above mentioned proportion, hydrogel composition

changes its state to liquid by body temperature when it is applied to the skin. It was also found that because of the above characteristics, substances included in hydrogel composition rapidly adhere and penetrate into skin.

For the invented hydrogel composition, Branched Gel Polymers and Electrolyte Gel Polymers are used as gel type substances. The Electrolyte Gel Polymers keeps the invented gel composition to stay in a gel state, and in some cases it keeps invented gel composition to stay in the gel state in room temperature (ideally between 0-30°C).

The Branched Gel Polymers acts as a substance to change the state from solid to liquid form when the temperature increases 10-50°C (ideally 30-40°C). Figure 2 shows the formation of the two polymers. Part (a) shows that physical bond of the branched gel polymer and electrical bond of the electrolyte gel polymer exists together. Part (b) shows the liquid state of the polymers where electrical bond of the electrolyte gel polymer exists but the physical bond of the branched gel polymer does not exist.

The Branched gel polymers are water soluble Polysaccharide Polymers which are Galactomannan, Glucomannan, Guagum, Locastgum and Plutonic. The Electrolyte gel polymers are Polysaccharide Polymers which are Aga, Algin, Carrageenan, Xantan and Gelan), Functional Additive 1-10 wt %(extracted from group of Chitosan derivative, Proteoglyucans, Elastin, Collagen and Hyaluronic acid.

Based on total weight, the Branched gel polymers have 1-10 wt % and the Electrolyte gel polymers have 0.5-5 wt %. If the composition is not within this range, gel state will not form nor will it change to liquid state even with increase in temperature.

Below stated skin-friendly enhancer will improve the acceptability of the skin to help the drugs to rapidly penetrate into skin, these substance are but not limited to the Polysaccharides like Chitosan, Proteoglycans, Chitosan derivative, Elastin, Collagen, Hyaluronic Acid or other Proteins that can be water soluble. The desired quantity of 0.5-5 wt % is based on the total weight of the composition. These skin-friendly enhancers are less effective if the substances contained less

than desirable amount, and also there will be a problem of stationary state as a gel if the substances contained more than the desirable amount.

Like the skin-friendly enhancers, below natural biomaterials are also added to improve the acceptability of the skin. They are natural substances that are extracted from plant, animal or mineral which are as follows but not limited to extracted substance from aloe, green tea, ginseng, wood vinegar, pine needles, propolis, ginkgo leaves, and mulberry leaves (silkworm). The desirable quantities are about 1-10 wt % based on total weight of the composition. These natural biomaterials are less effective if the substances contain less than desirable amount, but also there will be a problem of stationary state as a gel if the substances contain more than desirable amount.

Aliphatic Polyols like Propylene glycol and glycerine are soluble in water liquid which facilitates hydrogel composition to adhere and penetrate into the skin. The desirable quantities are about 3-30 wt % based on total weight. If the alcohol content is more than the desirable amount, formation of the gel state will be a problem. If it is less than the desirable amount, then the problem of stationary state as a gel will arise.

Functional additives listed below are the additives that can provide stability and functionality. They are propylparavin, Kojic acid, α -Hydroxy acid, imidazolidinylurea, twin80 and retinol. Desirable quantities are 1-10 wt % based on total weight of the composition. If the additive content are less than the desirable amount, stability will be decreased which would prohibit from long-term storage, and if it has more than the desirable amount, the problem of stationary state as a gel will arise.

Water is the main substance of the hydrogel composition that is based on total weight of the composition its quantity is about 30-93 wt %. Water content less than the amount will rise a problem of stationary state when the temperature rises, and more water will have a problem of not forming a gel.

Hydrogel composition comprised as above will have unique characteristics of staying in a gel state in temperature between 0-10°C, and changing to liquid state in 10-50°C. Also this invented hydrogel composition can remain as a gel state at 0-30°C or at room temperature, and transform to liquid state in 20-40°C

depending upon different amount of substances in the composition. As it was stated above, this invented hydrogel composition is sensitive to temperature difference and has characteristic of changing its states so that skin care substances in the hydrogel composition can rapidly and evenly penetrate into skin when it is applied directly to the skin.

The Hydrogel composition can be produced by the following method.

First, mix Branched gel polymer and electrolyte gel polymer into the Aliphatic Polyol and make the polymer solution, then mix the functional additive to the Aliphatic Polyol and make the functional solution. Combine the two polymer solution and the functional solution and produce the basic mixture solution.

Next step is to mix the basic mixture solution with the deionized water and heat the solution temperature to 45-95°C. While maintaining the temperature, add the acceptance enhancer and the natural biomaterials to the solution which will produce the liquid state Hydrogel composition. The amount of added substance should be as mentioned before, and their benefits have also been mentioned earlier.

Also, this invented hydrogel composition can be produced as a patch or sheet to be applied to skin. For example, to apply this invented hydrogel composition as a beauty care product, gel type hydrogel can be produced by cooling liquid hydrogel composition made in sheet or patch form to a temperature in between 45-95°C. Figure 3 shows the beauty care hydrogel sheet by inserting rayon textile as a wick into hydrogel composition. Part (a) is the rayon textile and part (b) is the invented hydrogel composition.

When this invented hydrogel sheet or patch is applied to the skin, the hydrogel will transform its state from gel to liquid by the body temperature which will add the flux to the hydrogel. Because this invented state-changing hydrogel changes to the liquid state by the body temperature when it is applied to the skin, this will let the hydrogel automatically adhere to the skin and the skin will accept more of the substance. Therefore, it is more effective in skin care than traditional hydrogel.

Below examples explains this invention in more detail. However, this does not limit the inventions categories.

<Examples>

Example 1

Mix glycerine 170g, Carrageenan 6g and Locastgum 20g at room temperature and stir in a 3 liter heatable container. Add to the mixture solution glycerine 30g, metilparaben 0.8g, propileparaben 0.3g. Add 740g of deionized water and heat the solution to 85°C. This will be the gel solution.

While maintaining the temperature at 85°C, add sequentially aloe extraction 20g, collagen 5g, imidazolidinylurea 2g, twin80 1.5g, and chitosan 3.7g to the gel solution. This is the hydrogel composition. Figure 1 shows the viscosity of the above hydrogel composition measured at various temperatures. As it is shown in Figure 1, the hydrogel composition decreases its viscosity when the temperature increases and transforms to liquid state.

Hydrogel sheet can be produced by adding a rayon textile as a wick to this hydrogel composition at the temperature of 80°C and then cooling it. This will be used to release beauty care ingredients to the skin.

Generally, when hydrogel is applied to skin the coverage is 40-70%. However, due to the characteristic of the invented hydrogel which is temperature sensitive state-changing, it has 100% coverage and faster migration rate of ingredient. It is a product that increases epidermal absorption of hydrogel.

*In the case of this invention, it is considered that additional explanation about epidermal absorption is needed when the hydrogel is applied to skin. However, please note that in a case when sufficient time is necessary for the concrete experiment and data entry, application should be submitted as it is. Then it could be reapplied within a year with domestic priority assertion.

[Invention Effectiveness]

The invented hydrogel composition is not only very effective in skin care but also effective in skin treatment if rapid delivery of drug or skin-friendly material is required. Especially, the invented hydrogel can be used very effectively in skin care transdermal cosmetic delivery.